

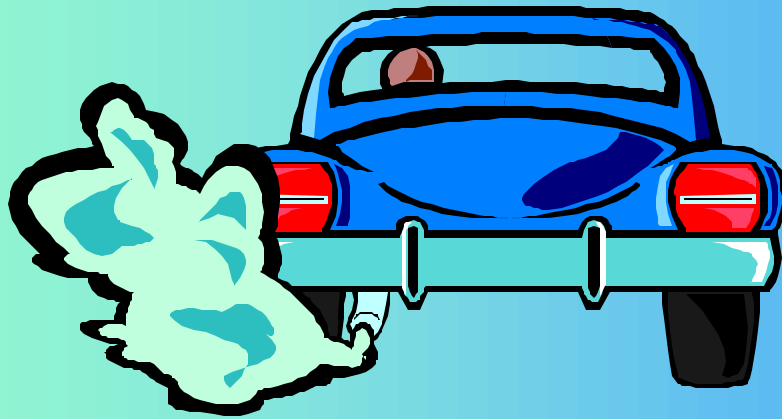
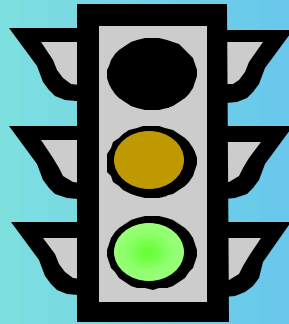
Small System Treatment Technology Selection



Does the System Really Want to Be in the
Water Treatment Business?

Alternatives to Treatment

- Improve Source Water Protection
- Improve System Operation and Maintenance (O & M)
- Switch to Higher Quality Source
- Purchase Water
- Consolidate

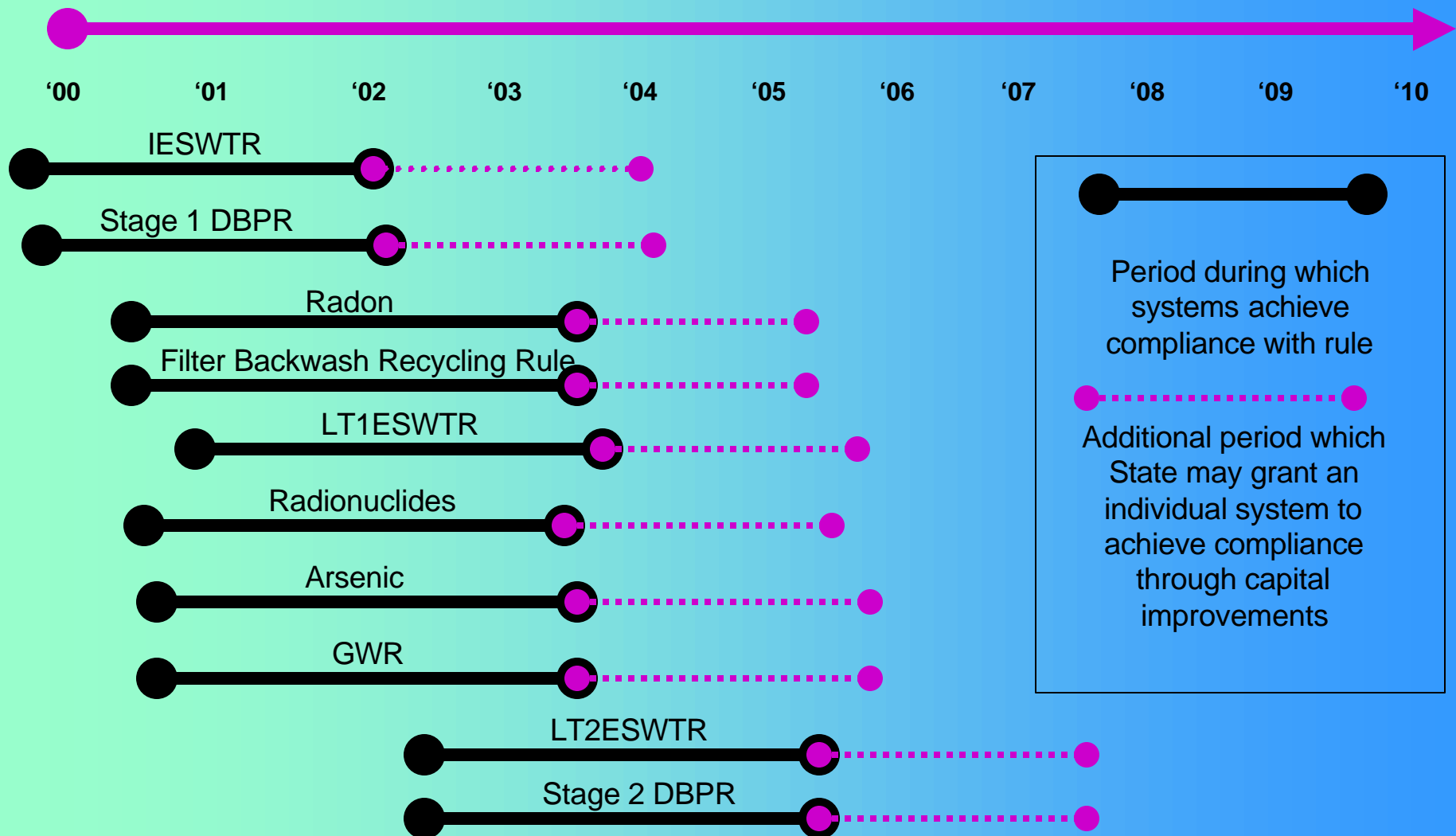


Go Forward with Treatment Selection if
No Practical and Economically Attractive
Alternatives to Treatment of a Current or
New Water Source Exist

Factors Influencing Treatment Selection

- System Characteristics
- Impact of Upcoming Rules
- Characteristics of Proposed Treatment(s)

Compliance Timeline



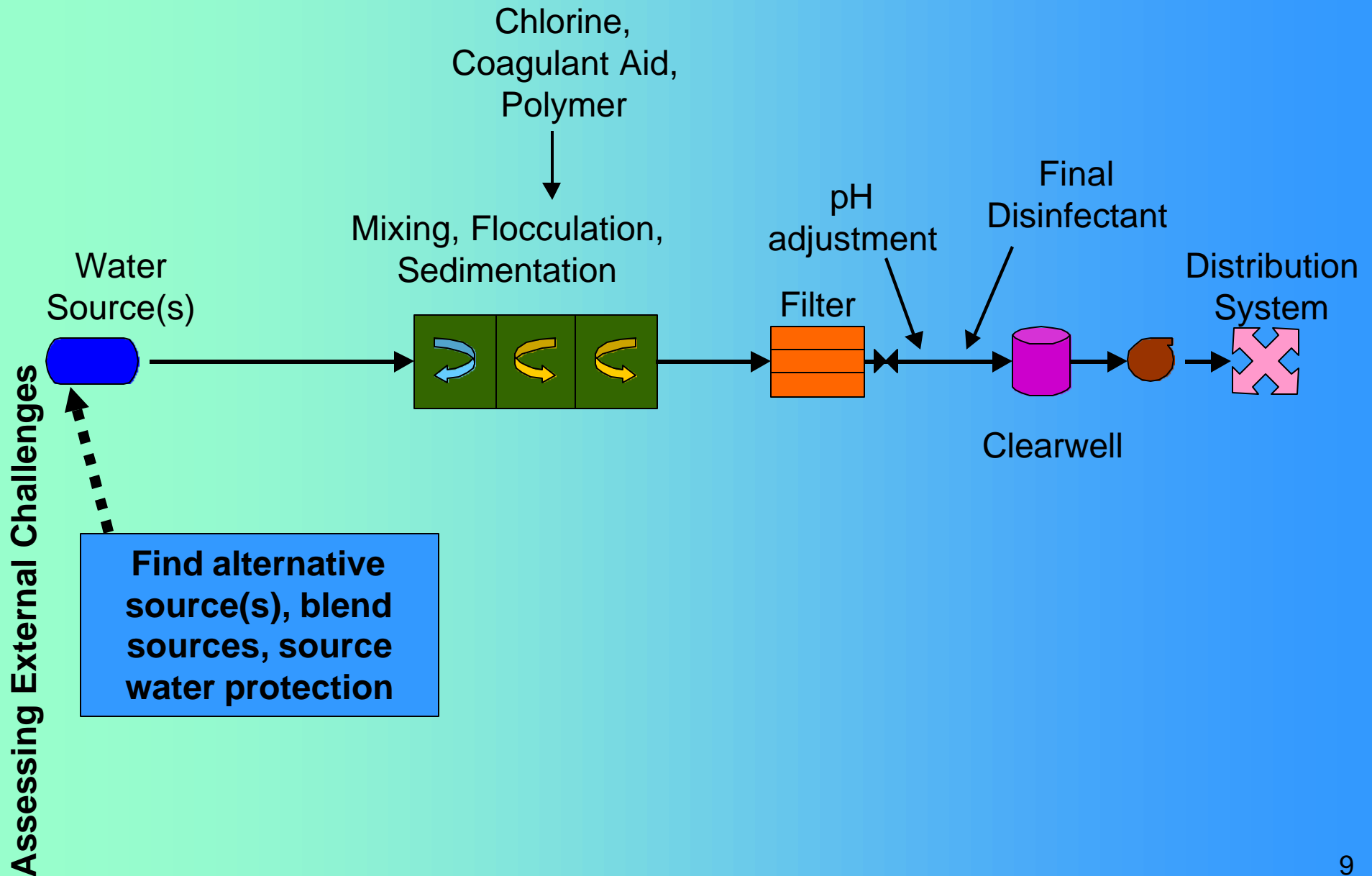
Characteristics of Proposed Treatment(s)

- Ability to Reliably Achieve Compliance
- Costs (Capital, O&M, Waste Disposal)
- Complexity and Flexibility
- Environmental Compatibility

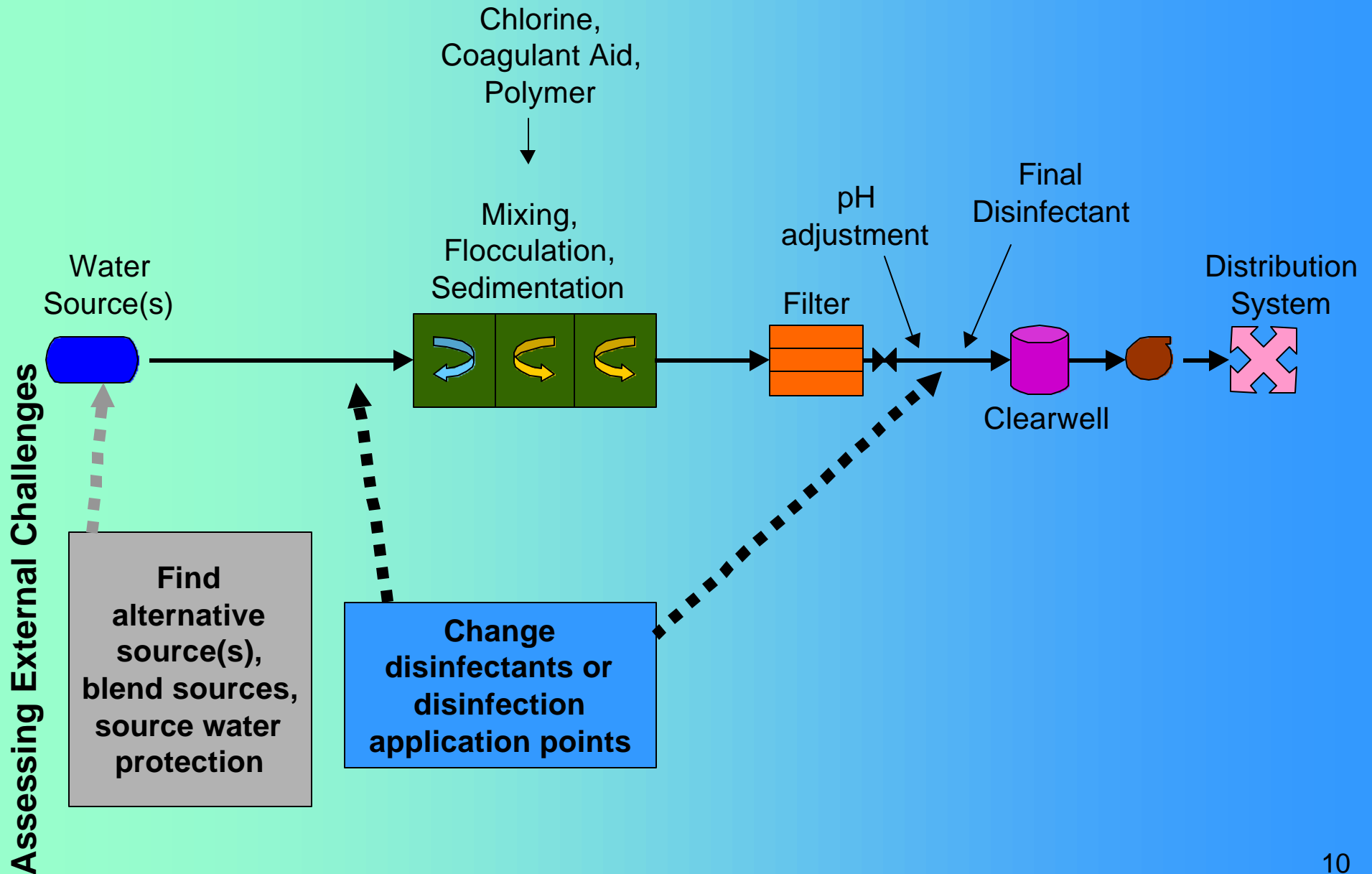
Treatment Options Analysis- Case Study

- System Characteristics
 - CWS, surface water, serves 2,500
 - Conventional filtration with chlorine disinfection
 - Raw TOC averages 3.2 mg/l
 - Alkalinity averages 95 mg/l
- Compliance Concerns
 - TTHMS average 0.085 mg/l
 - Treated TOC averages 2.3 mg/l
 - Turbidity is not less than 0.3 NTU 95% of the time
 - Turbidity excursions on individual filters
- Observations
 - Must reduce finished water TOC
 - Address turbidity

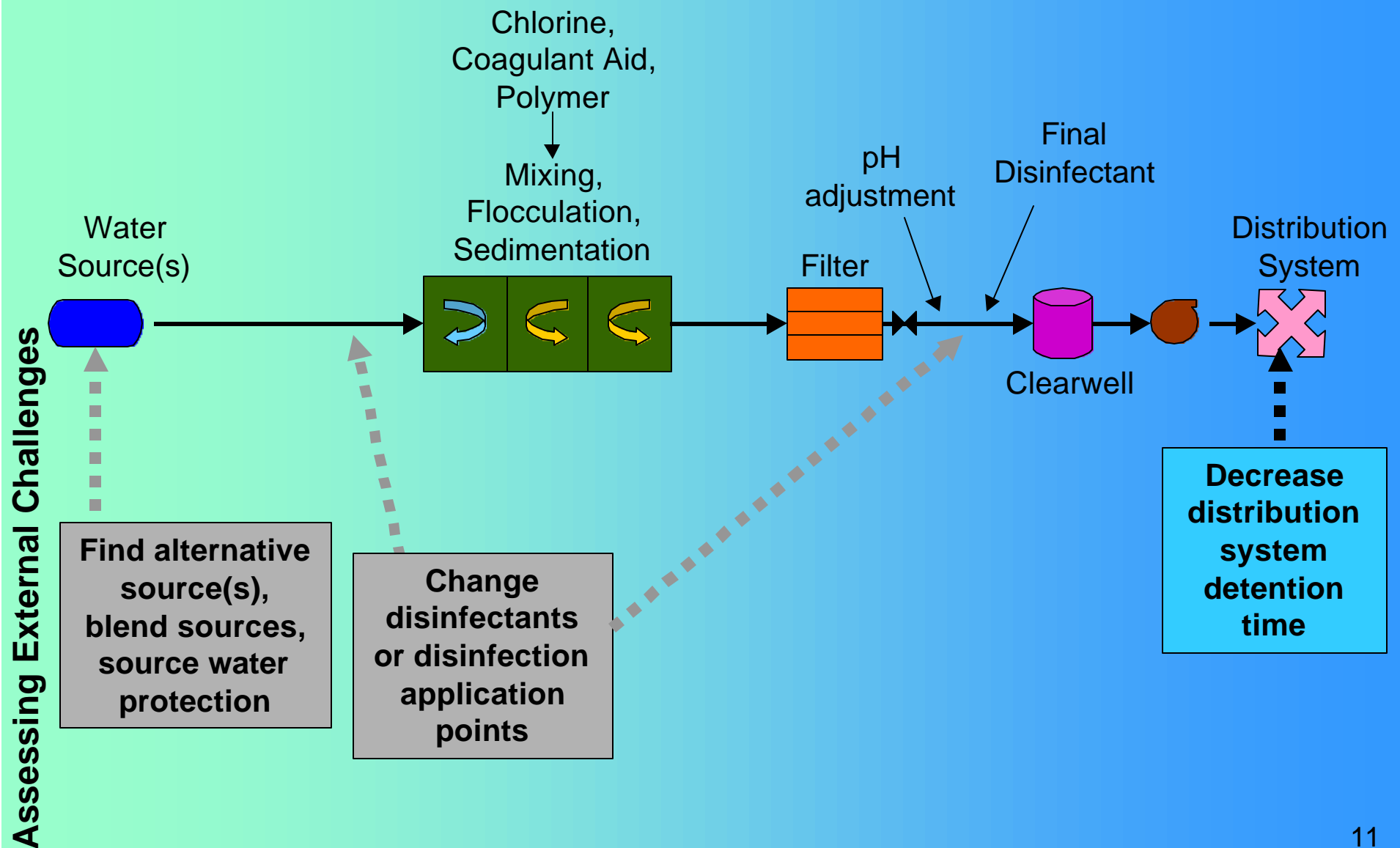
Treatment Options Analysis - Case Study



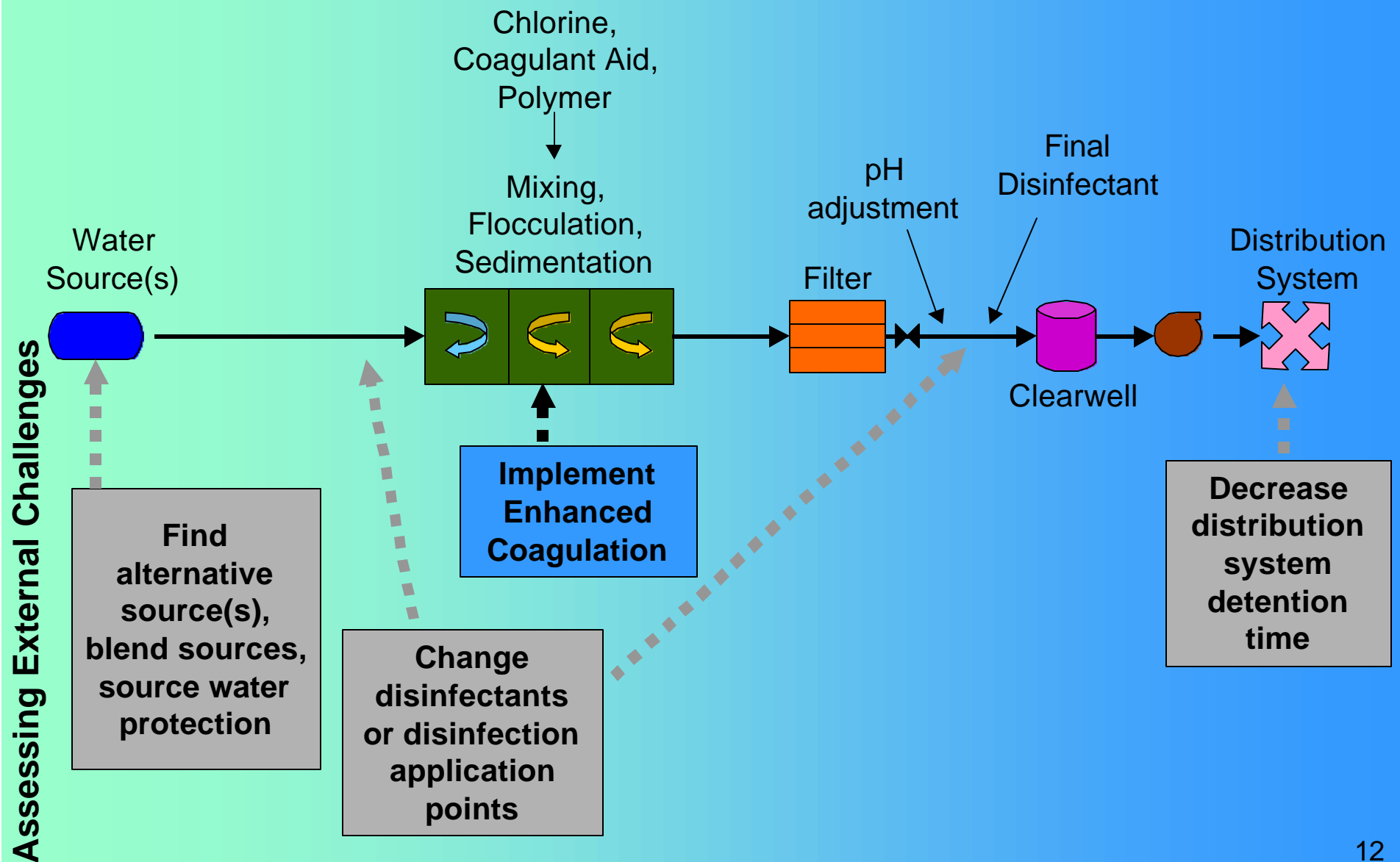
Treatment Options Analysis - Case Study



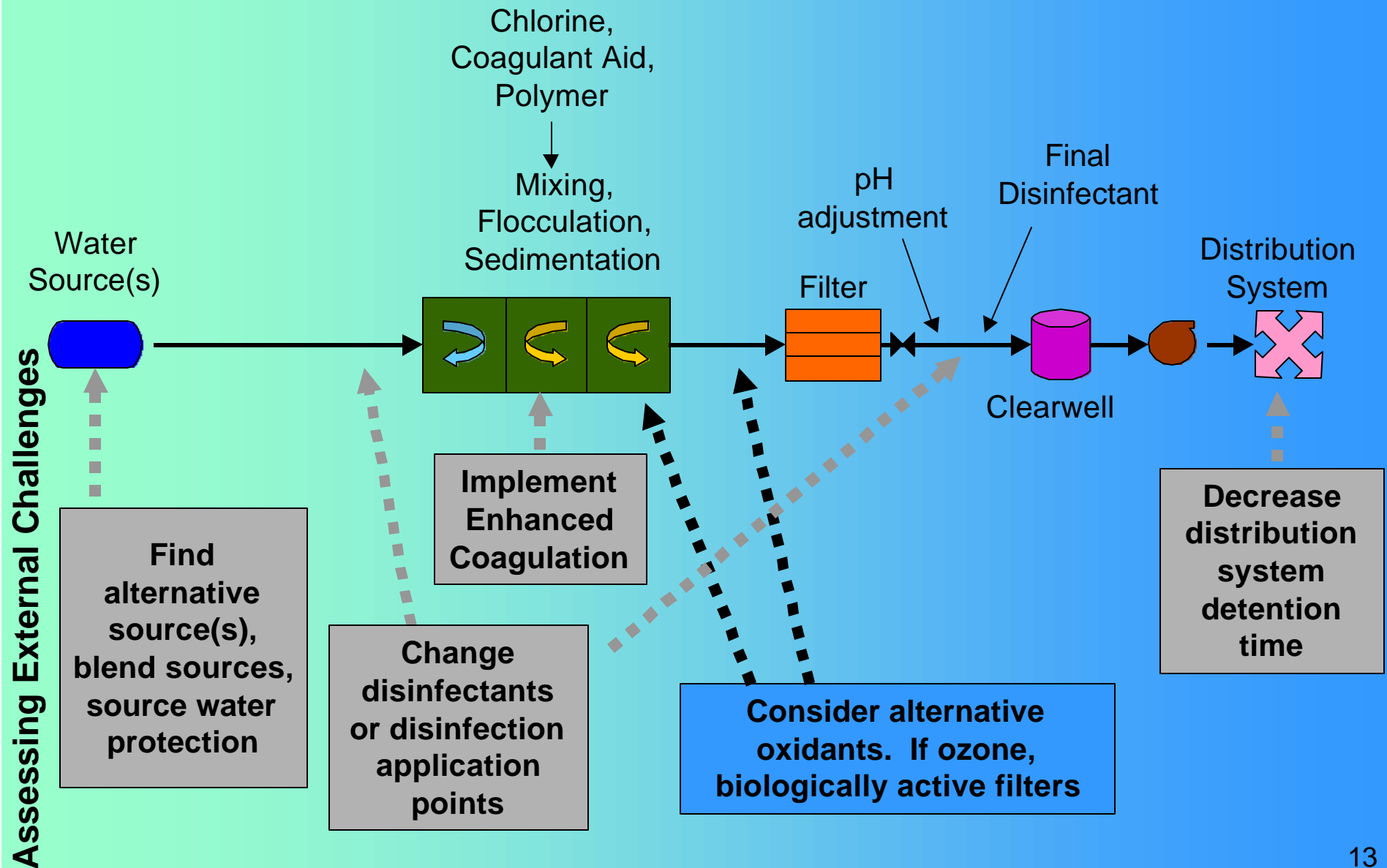
Treatment Options Analysis - Case Study



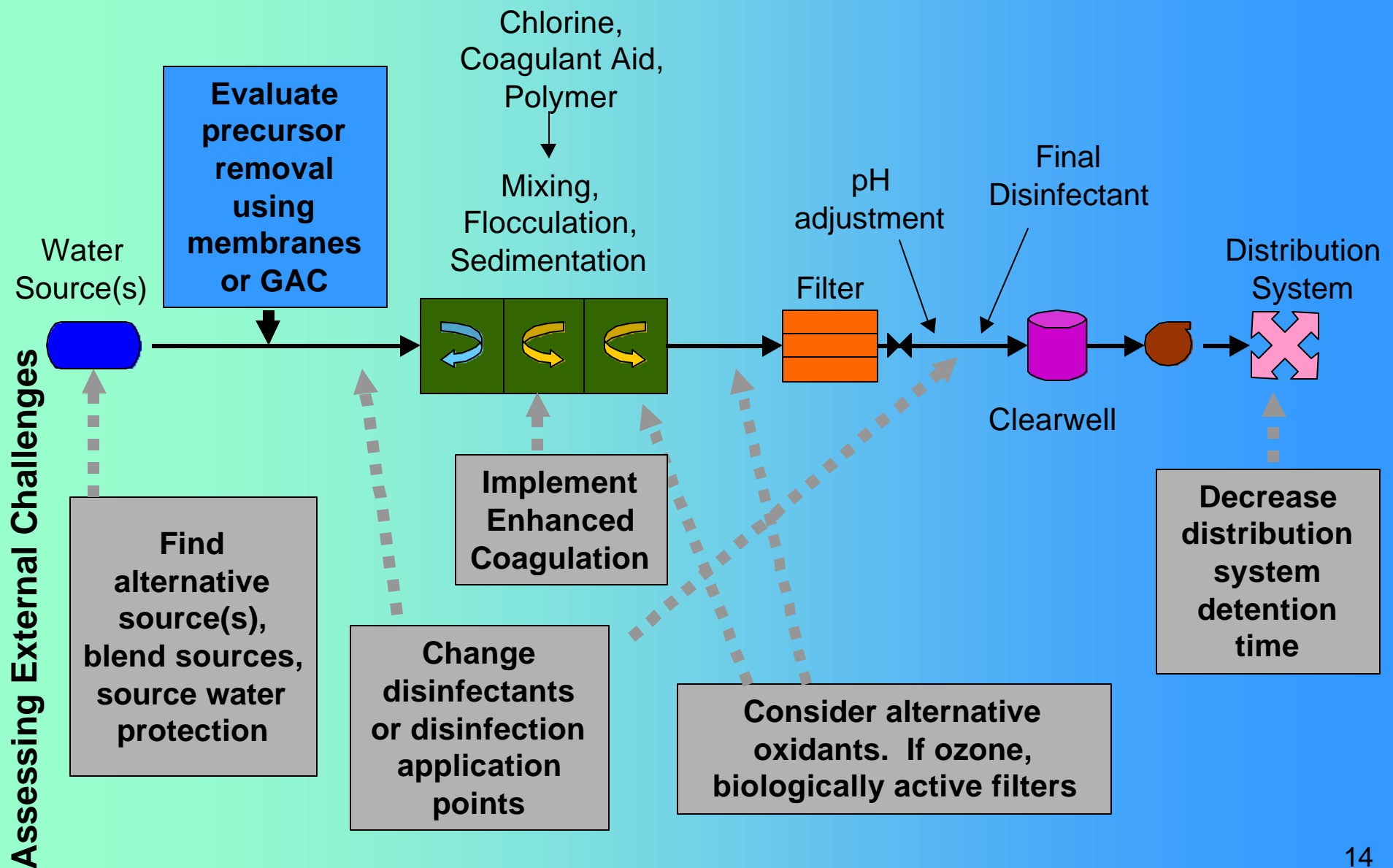
Treatment Options Analysis - Case Study



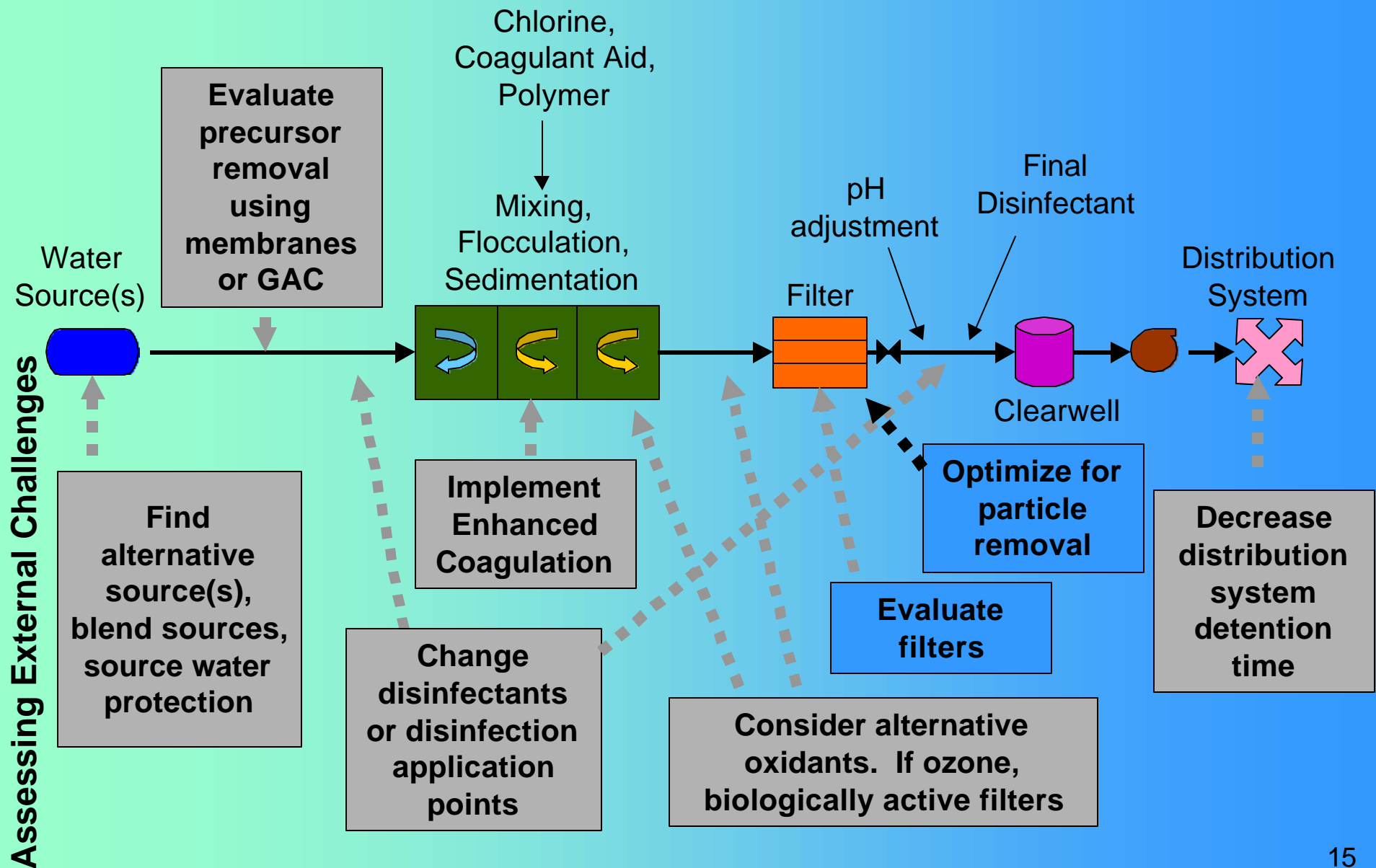
Treatment Options Analysis - Case Study



Treatment Options Analysis - Case Study



Treatment Options Analysis - Case Study



Conventional Treatment

- Pros:
 - Removal capabilities
 - Ability to treat source waters of low or inconsistent quality
- Cons:
 - Advanced operator
 - Adequate land
 - High costs
 - Sludge disposal



Membrane Filtration

- RO, NF, UF, MF
- Pros:
 - Removal capabilities
 - Size and flexibility
 - Intermediate operator
- Cons:
 - Water rejection (RO & NF)
 - Pre-treatments
 - Waste disposal (RO & NF)
 - High costs

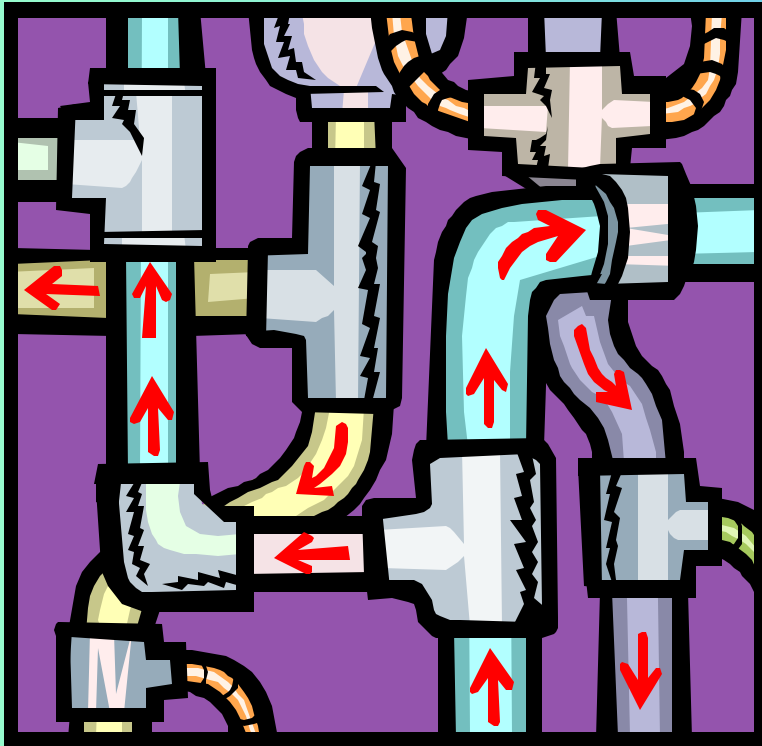


Ion Exchange

- Pros:
 - High removal rates
 - Low cost
 - Intermediate operator
- Cons:
 - Co-contaminants
 - Brine disposal



Disinfection



- I. Type
 - Chemical
 - Chlorine
 - Chloramines
 - Chlorine Dioxide
 - Ozone
 - Non-chemical
 - UV
 - Membranes
- II. Purpose
 - Primary
 - Secondary

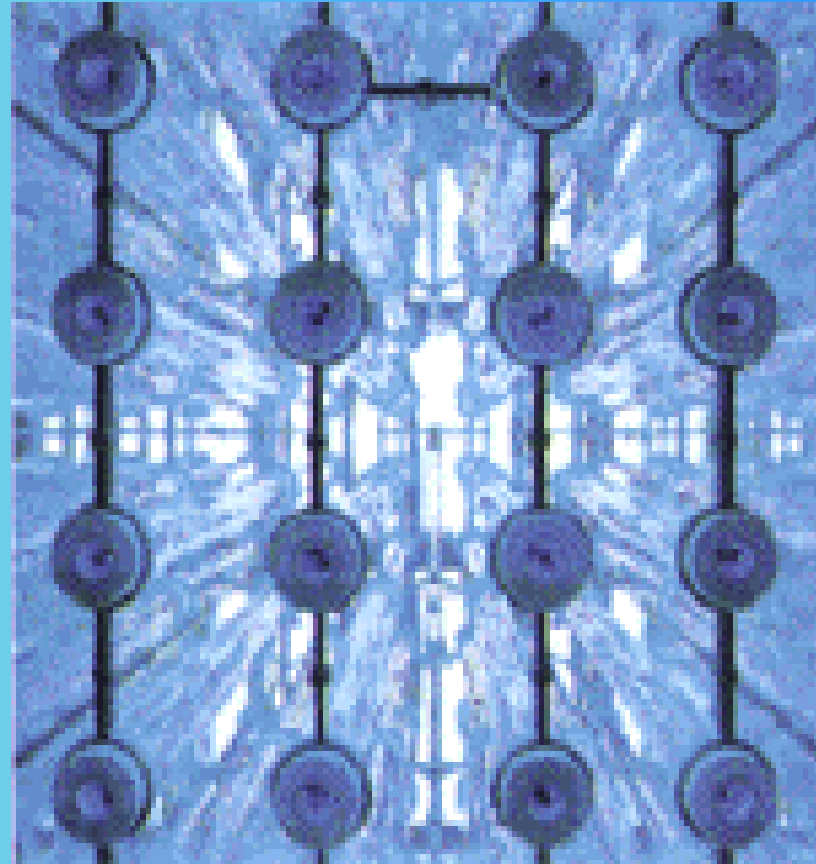
Chemical Disinfection

- Pros:
 - Compliance with GW and TC rules
 - Low cost (chlorine, chloramines)
 - Oxidation
- Cons:
 - DBP formation (especially chlorine, chlorine dioxide)
 - Additional disinfectant (ozone, chloramines)
 - Handling dangerous chemicals



Ultraviolet Light Disinfection

- Pros:
 - No THM precursors
 - Easy & safe operation
 - Generally low cost
- Cons:
 - No residual disinfectant
 - Not appropriate for waters high in TSS or turbidity
 - High doses required for cyst inactivation will increase costs



Granular Activated Carbon

- Pros:
 - Effective removal of SOCs, VOCs, Radon
 - Improved aesthetic quality
 - Relatively low cost
- Cons:
 - Co-contaminants may interfere with adsorption of selected contaminants
 - GAC must be replaced periodically

Centrally Managed POU

- Pros:
 - Generally more cost effective for very small systems
- Cons:
 - Significant maintenance, oversight, and customer education required
 - Not approved for microbial removal



Centrally Managed POE

- Pros:
 - Generally more cost effective for very small systems
- Cons:
 - Significant maintenance, oversight, and customer education required
 - Some states may restrict disposal options for certain devices

